Amendments to the Claims

This listing will replace all prior listings of claims in the present application. Amendments are shown by addition and ~~deletion~~ or [[deletion]] as needed for clarity.

In the Claims:

1. (Currently Amended) An apparatus comprising a first chamber and a second chamber and a membrane which divides the first and second chambers; the membrane comprising a porous support and a catalyst; the membrane being adapted to allow passage of a first reactant from the first chamber to the second chamber through said membrane; wherein the first reactant is imparted with enough energy by the catalyst upon said passage so as to react with the second reactant and wherein the membrane is adapted to activate molecules of the first reactant without forming an ionic species before reaction with the second reactant.

2. (Previously Presented) The apparatus as claimed in claim 1, wherein the support is adapted to operate at temperatures exceeding 250°C.

3. (Previously Presented) The apparatus as claimed in claim 2, wherein the support comprises an inorganic support.

4. (Previously Presented) The apparatus as claimed in claim 1, wherein the support comprises pores and there is a graduation in the average pore radii toward one surface of the support.

5. (Cancelled)

6. (Previously Presented) The apparatus as claimed in claim 1, wherein the support comprises a layer with a roughened surface which has an increased tortuosity compared to the tortuosity of the rest of the support.

7. (Previously Presented) The apparatus as claimed in claim 6, wherein the layer with a roughened surface is provided on an outer surface of the support.

8. (Previously Presented) The apparatus as claimed in claim 1, wherein a flux control layer is provided on the support.

9. (Previously Presented) The apparatus as claimed in claim 6, wherein a flux control layer is provided on a first surface of the support and the layer with a roughened surface is provided on an opposite surface of the support.

10. (Previously Presented) The apparatus as claimed in claim 8, wherein the flux control layer comprises an inorganic porous layer which is adapted to hold a portion of the catalyst therein and to control the passage of the first reactant through the membrane.

11. (Previously Presented) The apparatus as claimed in claim 8, wherein the flux control layer is selected from the group consisting of silica and gamma alumina.

12. (Previously Presented) The apparatus as claimed in claim 1, wherein the catalyst comprises a metal catalyst.

13. (Previously Presented) The apparatus as claimed in claim 12, wherein the metal catalyst is selected from the group consisting of rhodium, ruthenium, and nickel.

14. (Previously Presented) The apparatus as claimed in claim 1, wherein the membrane is provided in the shape of a cylinder.

15. (Previously Presented) The apparatus as claimed in claim 1, wherein the membrane comprises one or more struts.

16. (Previously Presented) The apparatus as claimed in claim 1, wherein the support comprises alpha alumina.

17. (Currently Amended) A method of producing hydrogen gas, the method

comprising:

providing a membrane, the membrane comprising a support and a catalyst;
passing a first reactant through the membrane from a first chamber to a second chamber;
allowing the first reactant to come into contact with the catalyst upon passage through said membrane;
imparting the first reactant with enough energy so as to react with the second reactant;
reacting the first reactant with a second reactant to produce hydrogen gas without forming an ionic species before reaction with the second reactant.

18. (Previously Presented) The method as claimed in claim 17, wherein the energy imparted on the first reactant activates molecules of the first reactant without forming an ionic species before reaction with the second reactant.

19. (Previously Presented) The method as claimed in claim 17, wherein the method is conducted at a temperature over 500°C.

20. (Previously Presented) The method as claimed in claim 19, wherein the temperature is between 700°C and 800°C.

21. (Previously Presented) The method as claimed in claim 17, wherein the first reactant is one of oxygen and a hydrocarbon, and the second reactant is the other of oxygen and a hydrocarbon.

22. (Previously Presented) The method as claimed in claim 21, wherein the oxygen and hydrocarbon do not come into contact with each other until the first reactant has passed through said membrane from the first chamber to the second chamber.

23. (Previously Presented) The method as claimed in claim 21, wherein the hydrocarbon comprises a normally gaseous hydrocarbon.

24. (Previously Presented) The method as claimed in claim 20, wherein the pressure within the first chamber is greater than the pressure within the second chamber.

25. (Previously Presented) The method as claimed in claim 20, wherein carbon monoxide is formed in addition to the hydrogen.

26. (Previously Presented) The method as claimed in claim 25, wherein the carbon monoxide and hydrogen are further reacted to produce normally liquid hydrocarbons in a Fischer-Tropsch type reaction.

27. (Previously Presented) The method as claimed in claim 20, wherein the hydrogen is recovered for use as a fuel.

28. (Previously Presented) A method of preparing a membrane for an apparatus as claimed in claim 1, the method comprising:

providing a support; and

adding a catalyst to the support.

29. (Previously Presented) The method as claimed in claim 28, wherein the support is an inorganic support.

30. (Previously Presented) The method as claimed in claim 28, further including the step of applying a coating to one of the surfaces of the support.

31. (Previously Presented) The method as claimed in claim 30, wherein the coating produces a roughened surface on the support, said surface having an increased tortuosity compared to the tortuosity of the rest of the support.

32. (Previously Presented) The method as claimed in claim 30, wherein the coating comprises a metal oxide or metal oxide precursor.

33. (Previously Presented) The method as claimed in claim 32, wherein the metal

oxide or precursor comprises a group IV metal oxide or group IV metal oxide precursor.

34. (Previously Presented) The method as claimed in claim 33, wherein the group IV metal oxide or precursor comprises TiO_2 or a TiO_2 precursor.

35. (Previously Presented) The method as claimed in claim 30, wherein the coating produces a flux control layer on the membrane.

36. (Previously Presented) The method as claimed in claim 30, wherein a second coating, the second coating being a flux control layer, is also applied to the support.

37. (Previously Presented) The method as claimed in claim 35, wherein the flux control layer is applied to the membrane by exposure to a boemite sol.

38. (Previously Presented) The method as claimed in claim 28, wherein at least one of a coating or a second coating is applied by dipping the support into a liquid comprising the coating.

39. (Previously Presented) The method as claimed in claim 28, including the step of applying the catalyst to a surface of the membrane by passing a catalyst precursor solution over a first surface of the support and an osmotic solution over the opposite surface of the support, and allowing the catalyst or a catalyst precursor to be deposited on the support via the process of osmosis.

40. (Previously Presented) The method as claimed in claim 28, further including the steps of drying the support and one or more of heating or firing the support.